A novel approach for hybrid repair of type B aortic dissection associated with coarctation of the aorta

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We report the case of an acute type B aortic dissection in association with an unknown isthmic coarctation in a 53-year-old man. An intimal tear was located just distal to the coarctation, and the intimal flap extended to the level of the renal arteries. Hybrid repair was performed successfully 4 months later, without deep hypothermic circulatory arrest. An extra-anatomic bypass connected the ascending aorta to the abdominal aorta. The coarctation was occluded using a ventricular septal defect occluder. The hybrid repair was safe and effective for the patient. (J Vasc Surg 2014;59:1422-5.)

Type B aortic dissection in association with isthmic coarctation is rare and may cause sudden death.[1] Successful surgical repair has been reported with cardiopulmonary bypass.[2-4] We used a novel approach to release the coarctation and block the flow of dissection.

CASE REPORT

A 53-year-old man presented with a history of severe central anterior chest pain that began 4 months earlier. He had a history of hypertension for ~20 years, without optimal blood pressure control. Blood pressures were 185/70 mm Hg in the right arm, 180/70 mm Hg in the left arm, and 80/50 mm Hg in the lower limbs. Radial pulses were present and symmetrical, whereas femoral pulses were reduced. The results of the cardiorespiratory examination were normal.

Computed tomography angiography of aorta demonstrated an isthmic coarctation with a diameter of 5.3 mm. An intimal tear was located distal to the coarctation (Fig 1, *A*). The intimal flap extended to the level of renal arteries (Fig 1, *B*). Aortic dilatation started from the bottom of the coarctation and extended to the level of superior mesenteric arteries, with a maximum diameter of 63 mm. Marked internal mammary artery collateral formation supplied the descending thoracic aorta. The patient's coronary arteries and aortic valve were normal. After a detailed review of the patient's imaging data and careful preprocedural planning, a hybrid repair of the aortic dissection and aortic coarctation was selected.

General anesthetic procedures were used during surgery. The ascending aorta was exposed through a midline sternotomy. A midline laparotomy incision revealed a normal distal abdominal artery and lilac arteries. After heparinization, ascending aorta-to-infrarenal abdominal aorta bypasses was performed, without cardiopulmonary bypass or deep hypothermic circulatory arrest. A side-biting vascular clamp was applied, and a 22- × 300-mm MAQUET graft (MAQUET, Wayne, NJ) was sutured in an end-to-side anastomosis to the infrarenal abdominal aorta. The graft was allowed to fill in a retrograde manner and was placed in a curvilinear fashion before the liver, through the diaphragm, and anastomosed to the anterior side of the ascending aorta in the same manner (Fig 2). After the operation, blood pressure was 120/60 mm Hg in the arms and 105/65 mm Hg in the lower limbs.

The interventional procedure was performed 3 days later in a catheter procedure suite with digital subtraction imaging. Local anesthesia and conscious sedation were used. Right percutaneous femoral and left radial artery accesses were used with 6F sheaths. Angiography of the entire aorta was obtained with a calibrated pigtail catheter (Cook Group Inc, Bloomington, Ind), followed by careful measurements of the coarctation. The right femoral artery sheath was then exchanged with an 8F sheath over a 0.035-inch super-stiff Glidewire (Terumo, Tokyo, Japan).

An 8F/180°, 85-cm-long ventricular septal defect (VSD) occluder delivery system (Starway Medical Technology Inc, Beijing, China) was advanced from the right femoral artery over a 0.035-inch super-stiff guidewire in the true lumen of the thoracic aorta and advanced through the origin of the coarctation. The maximum diameter at the site of the coarctation was 6 mm, and the narrowest segment was 2 mm. The systolic gradient was 90 mm Hg.

The true lumen of the descending thoracic aorta appeared to be very small, being compressed by the false lumen (Fig 3, *A*). The false lumen originated distal to the coarctation and extended to just above the renal arteries, where it communicated with the true lumen. A 12-mm VSD occluder (Starway Medical Technology Inc) was placed distally, blocking flow through the true lumen.

Angiography of the ascending aorta and the aortic arch revealed a patent bypass and satisfying positioning of the occluder. The true lumen and the false lumen at the thoracic descending aorta were successfully excluded from the arterial circulation (Fig 3, *B*). No residual leakage was found. A 6F Perclose ProGlide suture closure device (Abbott Vascular, Abbott Park, Ill) was deployed.

Recovery after the hybrid repair was uneventful, with normalization of the pressure gradient between the upper and lower limbs. The patient was discharged on the seventh day after the operation in good condition.

The follow-up computed tomography angiography 6 months later disclosed partial thrombosis in the false lumen and that the density of the false lumen was lower. The diameter of the aneurysm

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Fig 1. A, Curved-planar reformation of the computed tomography angiography revealed the coarctation (*long arrow*), the intimal tear (*short arrow*), and re-entry (*black arrow*). **B,** Multiplanar reconstruction showed the main fenestration (*arrow*).

Fig 2. A, Three-dimensional computed tomography angiography with volume rendering showed the extra-anatomic bypass, the native aorta with the congenital coarctation, and a dilated dissected artery. **B,** The perfusion of the visceral arteries was good.

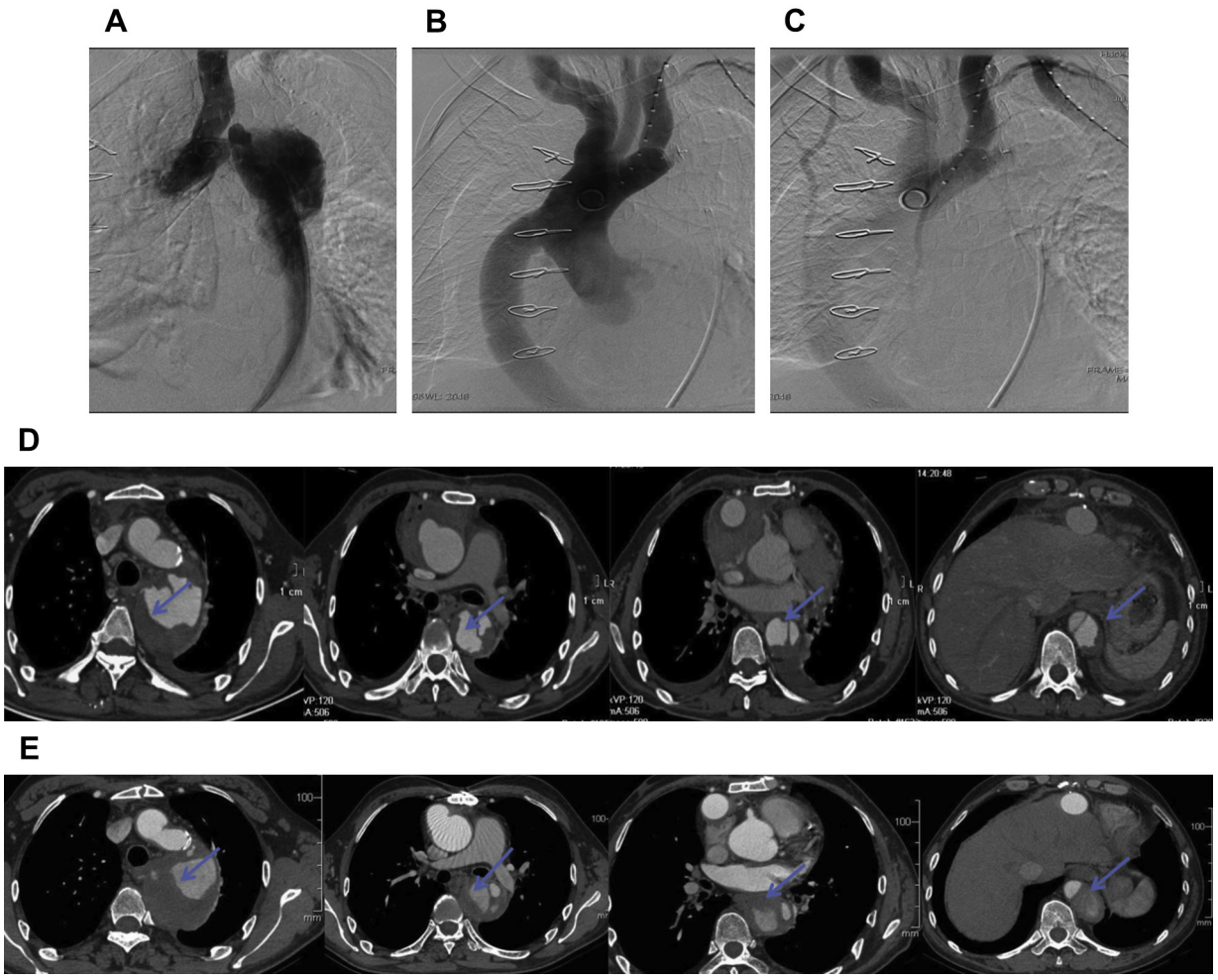

Fig 3. A, Preintervention aortography demonstrated the coarctation was discrete and the dissected artery was distal to the coarctation. **B,** Postinterventional aortography showed the patency of the bypass graft. **B** and **C,** The thoracic descending aorta was completely excluded from the ascending aorta. Postoperative computed tomography angiography at **(D)** 3 days and **(E)** 6 months demonstrated dynamic change of the partial thrombosis in the false lumen (*arrows*).

was about 5 mm smaller than before, and the aneurysm was perfused to some extent (Fig 3, *D* and *E*).

DISCUSSION

Aortic dissection distal to isthmic coarctation is an extremely rare pathologic combination but a serious problem. The present case is the first patient, as far as we know, to undergo operative repair, without cardiopulmonary bypass, and interventional therapy to block the flow.

Commonly, surgical repair of this pathologic combination is performed under hypothermal circulatory arrest and cardiopulmonary bypass. Duration of aortic cross-clamping, drop in spinal cord perfusion, and reperfusion injury will increase the risk of spinal cord ischemia. In this patient, however, the bypass graft was implanted without cardiopulmonary bypass, and the duration of surgery was 2 hours, which was beneficial to the perfusion of the whole body. Endovascular stent graft use has been increasing in coarctation and aortic dissection[5-7] but seldom in this combination. It was not optimal to release the coarctation and cover the intimal tear in this patient because of the short distance between the intimal tear and the left subclavian artery as well as the narrow angle between the precoarctation and postcoarctation. Here, we selected a VSD occluder to treat the aortic dissection. The true lumen and the false lumen were both occluded from the site of coarctation by the VSD occluder. Because the distal inflow from the re-entries was insufficient, the false lumen would gradually thrombose and the true lumen would maintain the spinal circulation from the retrograde flow.

We acknowledge some limitations in this kind of therapy. The primary tear and the re-entry were not managed, and the dissecting aneurysm was untreated. Although the true lumen of the proximal descending aorta was blocked, the false lumen will potentially continue to be

perfused in a retrograde manner. The patient should be monitored closely.

CONCLUSIONS

Our experience in this case shows that hybrid repair by a graft bypass of the ascending aorta to the abdominal aorta and occlusion of the coarctation with an occluder is feasible, convenient, and effective as well. On the basis of our experience, this novel approach has been proposed as the latest means to improve the effectiveness and safety of the procedure for patients with this complex aortic problem.

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